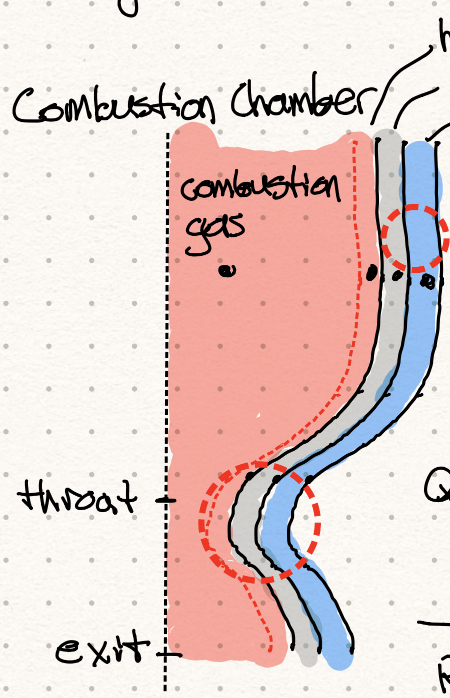
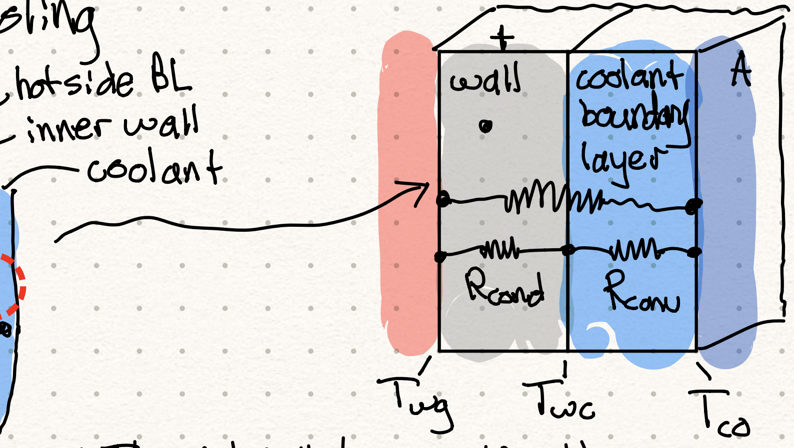
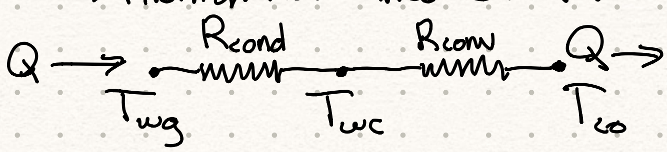
Regenerative Cooling





→ Thermal resistance circuit



$$Q = \frac{T_{wg} - T_{wc}}{R_{cond}}$$

$$R_{cond} = \frac{t}{kA}$$

$$Q = \frac{T_{wc} - T_{co}}{R_{conv}}$$

$$R_{conv} = \frac{1}{h_c A}$$

→ resistors add in series

$$R_{eq} = R_{cond} + R_{conv}$$

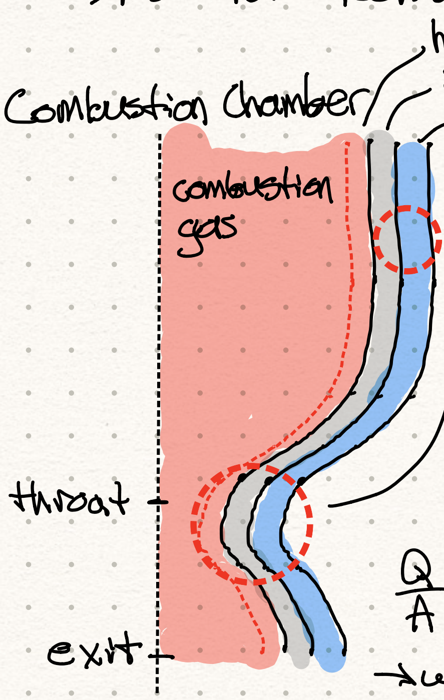
$$Q = \frac{T_{wg} - T_{co}}{R_{eq}}$$

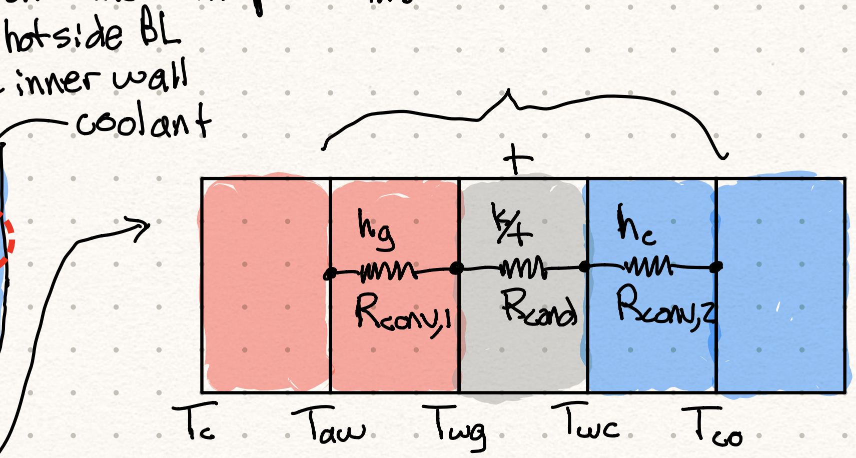
* given T_{co}, T_{wg}, so solve for Q

→ Now we can solve for T_{wc}:

$$Q = \frac{T_{wc} - T_{co}}{R_{conv}} \rightarrow T_{wc} = T_{co} + Q R_{conv} = T_{co} + Q/h_c A$$

→ Now lets look at the "full" problem:





→ we know T_c & T_{co}, can get T_{aw} from recovery factor

$$\frac{Q}{A} = h_g(T_{aw} - T_{wg}) = \frac{k}{t}(T_{wg} - T_{wc}) = h_c(T_{wc} - T_{co}) = H(T_{aw} - T_{co})$$

→ what is H? look at resistance network!

$$R_{eq} = R_{conv,1} + R_{cond} + R_{conv,2} = \frac{1}{h_g A} + \frac{t}{kA} + \frac{1}{h_c A} = R_{eq}$$

$$\rightarrow Q = \frac{T_{aw} - T_{co}}{R_{eq}} = \frac{T_{aw} - T_{co}}{\frac{1}{h_g A} + \frac{t}{kA} + \frac{1}{h_c A}} \rightarrow H = \frac{1}{R_{eq}}$$

→ Now we can calculate Q, and get intermediate temeratures using

$Q = h_g(T_{aw} - T_{wg})$, $Q = h_c(T_{wc} - T_{co})$

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